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# The MONTHLY REVIEW

Published Monthly by the

*American Electro-Platers Society*

A SOCIETY FOR THE ADVANCEMENT

OF THE

SCIENCE OF ELECTROPLATING

JULY, 1932

Entered as second class matter at the Post Office at Springfield, Mass., September 8, 1930, under act of August 24, 1912.

Acceptance for mailing at special rate of postage, provided for in section 1103, Act of February 28, 1925, authorized September 8, 1926.

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MONTHLY REVIEW

Published by the

American Electro-Platers Society

Publication and Editorial Office

90 Maynard St., Springfield, Mass.

VOL. XIX JULY, 1932 No. 7

# The Convention

The twentieth annual convention of the American Electro-Platers Society was held in the Benjamin Franklin Hotel, Philadelphia, from June 20-23. It was very successful in spite of the prevailing industrial conditions, about 300 delegates and their wives being in attendance. Splendid papers were read at the educational sessions and were well received judging from the discussion that followed.

The social side of the convention was taken care of by the Fellowship Club and included the Monday evening affair, which was very successful. There was plenty of fun, dancing followed the entertainment and refreshments were served at intervals during the evening.

A great many familiar faces were missing from this year's convention, due no doubt to economic conditions. Those who did attend, however, were both optimistic and cheerful.

The business meeting on Thursday afternoon was mostly devoted to the amendments to the Constitution as proposed by New York Branch. Most of these changes were adopted and a new copy of the By-laws and Constitution will be printed to bring everything up to date. A discussion relative to the printing of the Monthly Review was the next item of business. After a voice vote regarding paid advertising in the Review, the president declared the motion lost by a small margin. As there is practically no money in the treasury, the printing of the Review for the coming year was discussed at length. It was finally decided to accept the suggestion of the Judiciary Committee to have the Review published quarterly

instead of monthly for one year. The following officers were then elected:

| | | |
|---|---|---|
| *President* | CLARENCE VAN DEREAU | Dayton Branch |
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| *2nd Vice-Pres.* | T. F. SLATTERY | Baltimore-Wash. Br. |
| *Sec.-Treas.* | H. A. GILBERTSON | Chicago Br. (re-elec.) |
| *Editor* | WM. J. R. KENNEDY | Hartford-Conn Valley Br. (re-elected) |

Chicago was unanimously chosen as the meeting place for 1933.

Past President John E. Sterling, New York Branch, installed the incoming officers. The new President then declared the meeting adjourned.

## *Important Notice to All Our Members*

In order to meet our financial obligations, it has been found necessary to reduce the expense incurred in printing the Monthly Review. By action of the Convention, it was voted to publish the Review quarterly instead of monthly for one year. The next issues will, therefore, be published as follows: October, 1932, January, April, June, 1933.

Branch secretaries are asked to co-operate with us as usual in reporting the branch news monthly, and to aid all they can in cutting our expenses to a minimum in order to balance the budget.

W. J. R. KENNEDY.
*Editor.*

## Obituary

Mr. J. Magill, one of Toronto Branch's oldest and most active members, died at his residence, 153 Marguretta St., Toronto, on May 25, 1932.

In the passing of Mr. Magill the entire Society has lost a most valuable and sincere member. He was always ready at any time to lend a helping hand to anyone. The platers class of Toronto Technical School will miss him, as he was the instructor for several seasons. He also had published several very instructive papers on the electroplating industry.

The Society extend their sincere sympathy to his bereaved family. He will be missed by all.

# THE CHEMICAL CONTROL OF CYANIDE SILVER-PLATING SOLUTIONS*

By R. M. Wick

A preliminary report on the analysis of silver-plating solutions was read at the Washington, D. C., Convention of The American Electro-Platers Society, and printed in the Monthly Review for December, 1930. This paper is a summary of the final and more complete publication of that research[1].

The advantages gained by chemical control of plating solutions are well recognized by electroplaters, yet such control is not universal. Cyanide silver-plating solutions may be worked, although not most efficiently, over a fairly wide range of composition, and it is partly on this account that operators of smaller installations do not analyze the solutions.

Silver, free cyanide and carbonate are the most common determinations for control. Silver need not be determined often, as its concentration does not change rapidly in a good silver bath. Free cyanide should be determined more frequently, in order to govern the additions of cyanide. The rate of loss of cyanide is fairly constant in a working bath, so that after some experience the need for cyanide can be roughly predicted. The increase in carbonate content follows closely the loss in cyanide, and as the carbonate content is not critical, it need not be frequently determined.

The determination of other constituents, mainly chloride, iron, or copper, needs to be made only when the working of the bath indicates the possibility of trouble due to their presence. It is well, nevertheless, to know the extent of contamination with these substances. The other determinations included in the full report are chiefly of interest in research work. In general, duplicate determinations should be made.

1. *Free Cyanide.*

Free cyanide is the alkali cyanide present in the plating solution which is not combined with the silver (or other metals that may be present, such as copper or iron). It is determined by measuring the volume of silver nitrate solution of known strength

1. R. M. Wick. The Analysis of Cyanide Silver-Plating Solutions. B. S. Jour. Research, Vol. 7, p. 913; 1931.

*Publication Approved by the Director of the Bureau of Standards of the U. S. Department of Commerce.

required to just cause a precipitate (the Liebig titration). The addition of potassium iodide gives a sharper end point, and corrects for errors caused by other constituents of the bath.

*Solutions Required.*

(a) Silver nitrate, 0.1 *N*. Dissolve exactly 17 grams of pure dry silver nitrate crystals ($AgNO_3$) in distilled water and dilute to one liter in a graduated flask.

(b) Potassium iodide, 3%. Dissolve about 3 grams of potassium iodide (KI) in 100 ml. of distilled water.

*Procedure.*

(1) Measure from a burette or pipette[2] 10 ml. of plating solution into a 400 ml. beaker.

(2) Add 5 ml. of 3 per cent potassium iodide solution and 200 ml. of distilled water.

(3) Place the beaker and its contents on a sheet of black paper.

(4) Run in 0.1 *N* silver nitrate solution from a burette, stirring the solution vigorously, until a faint permanent cloudiness appears upon the addition of one drop of the titrating solution. Up to this point the cloudiness disappears on stirring.

(5) Record the volume of silver nitrate solution required.

*Calculations.*

Multiply the volume of 0.1 *N* silver nitrate solution used for 10 ml. of the plating bath by the appropriate factor to obtain the concentration of alkali cyanide.

| *To obtain:* | *Multiply ml. by* |
|---|---|
| Sodium cyanide, grams per liter (g/1 NaCN) | 0.98 |
| Sodium cyanide, ounces per gallon (oz/gal NaCN) | .26 |
| Potassium cyanide, grams per liter (g/1 KCN) | 1.30 |
| Potassium cyanide, ounces per gallon (oz/gal KCN) | .35 |

2. *Alkali Carbonate.*

Carbonate is present in all cyanide plating baths, as it is formed when alkali cyanide reacts with the carbon dioxide of the air. It can be determined by measuring the amount of standard hydrochloric acid required to react with it; phenolphthalein, an indicator, changes color when this reaction has occurred. Free alkali cyanide also reacts with the acid, but not the cyanide that has been combined with silver. The following method involves titration of the carbonate with acid after the cyanide has been "fixed" by adding sufficient silver nitrate to produce a turbidity.

2. Do not pipette cyanide solutions with the mouth; use mechanical suction.

*Solutions Required.*

(a) Hydrochloric acid, 0.5 *N*.

(b) Phenolphthalein indicator solution. Dissolve 1 gram of pure phenolphthalein in 100 ml. of alcohol.

(c) Silver nitrate, 0.1 *N*.

*Procedure.*

(1) Titrate a 10 ml. sample of plating solution with silver nitrate as in 1 but without the addition of iodide.

(2) Add 3 drops of phenolphthalein indicator solution.

(3) Run in standard hydrochloric acid solution from a burette until the pink color is just discharged.

(4) Record the volume of standard hydrochloric acid solution used.

*Calculations.*

Multiply the volume of 0.5 *N* hydrochloric acid solution used for 10 ml. of plating solution by the appropriate factor to obtain the concentration of alkali carbonate.

| *To obtain:* | *Multiply ml. by* |
|---|---|
| Sodium carbonate, grams per liter (g/l $Na_2CO_3$) | 5.3 |
| Sodium carbonate, ounces per gallon (oz/gal $Na_2CO_3$) | .71 |
| Potassium carbonate, grams per liter (g/l $K_2CO_3$) | 6.9 |
| Potassium carbonate, ounces per gallon (oz/gal $K_2CO_3$) | .92 |

3. *Silver.*

A. *Separation from the Cyanide.*

Most methods for the determination of silver (except the electrolytic method) necessitate the separation of the silver from the cyanide. This can be accomplished either by precipitating the silver or by decomposing the cyanide solution.

1. *Precipitation of Silver:*

(a) As sulphide—Silver can be precipitated by the addition of ammonium sulphide to the cyanide solution. This procedure separates it not only from the cyanide, but also from ferrocyanide and metallic impurities excepting mercury, which also precipitates as sulphide. Coagulation and complete precipitation of the silver sulphide are favored by boiling the ammoniacal solution. This boiling should be done with good ventilation since poisonous ammonium cyanide is volatilized. The silver sulphide can be filtered out, washed, and dissolved in nitric acid to prepare it for titration.

(b) As silver—Metallic silver can be precipitated by boiling the solution with pure granulated zinc. The precipitate, which contains the silver and excess of zinc, is then dissolved in nitric acid.

2. *Decomposition of the Cyanide:*

If sulphuric acid is added to the cyanide solution, silver cyanide is precipitated and hydrocyanic acid is evolved. The operation should therefore be conducted with very good ventilation. On strong heating the silver cyanide slowly dissolves. This dissolution can be hastened by adding initially a volume of concentrated sulphuric acid equal to twice the volume of plating solution. When commercial cyanide solutions are thus evaporated until fumes of sulphuric acid appear, darkening usually occurs. This disappears on the addition of a few milliliters of concentrated nitric acid and re-evaporation to fuming. After cooling, the residue is dissolved in water. The resulting solution contains sulphates of all the metals present in the plating bath.

B. *Determination of Silver.*

Any of the methods for the determination of silver which have been described is capable of giving satisfactory results, and the choice of the method to be used depends on the facilities which are available. Decomposing the plating solution with sulphuric acid is preferable if a good hood is available. Precipitation of silver as sulphide, or by using zinc, requires slightly more time, but it avoids the generation of large amounts of hydrocyanic acid. Precipitation methods are probably best adapted to the requirements of the average plating establishment.

1. *Volhard Titration:*

The solution of silver nitrate or silver sulphate obtained by any of the above methods is titrated with thiocyanate solution, using ferric alum as the indicator. The thiocyanate is standardized against silver nitrate. The presence of filter paper remaining from the solution of the silver or silver-sulphide precipitate is unobjectionable. Usually it is preferable, for high accuracy, to treat the silver nitrate sample used for standardization in the same way as the plating solution. If small amounts of mercury are present, they will be included in this titration.

2. *Precipitation as Silver Chloride:*

Silver chloride can be precipitated by the addition of hydrochloric acid to the silver solutions obtained by any of the above

methods. It can then be weighed, or dissolved in standard cyanide and the excess cyanide determined by the Liebig titration, preferably with iodide present (see section 1).

3. *Electrolytic Determination:*

Silver can be directly deposited from a diluted sample of the plating solution, to which additional cyanide has been added.

*Solutions Required.*

(a) Ammonium sulphide, 6 *N*. Pass hydrogen sulphide gas into 200 ml. of concentrated ammonium hydroxide (sp.gr. 0.90) in a cooled bottle until it is no longer absorbed; add 200 ml. of concentrated ammonium hydroxide and dilute to 1 liter.

(b) Nitric acid, 1:4. Add concentrated nitric acid (sp.gr. 1.42) to four times its volume of water.

(c) Ferric ammonium alum solution. Make a saturated solution of the alum (chloride free) and add enough nitric acid to discharge the brown color.

(d) Potassium thiocyanate solution, 0.1 *N*. This salt is hygroscopic and the solution cannot be accurately prepared by weighing out the dried salt. Dissolve about 10 grams of potassium thiocyanate (KCNS) in a liter of water and standardize against 0.1 *N* silver nitrate solution.

(e) Silver nitrate solution, 0.1 *N*. (See above.)

*Procedure.*

(1) Measure from a burette 10 ml. of plating solution into a 250 ml. beaker, and dilute to 150 ml.

(2) Add about 10 ml. of ammonium sulphide solution.

(3) Boil gently until the black precipitate of silver sulphide has coagulated.

(4) Filter, wash and transfer the filter paper and precipitate to a 300 ml. Erlenmeyer flask.

(5) Add 10 ml. of 1:4 nitric acid and 25 ml. of distilled water; boil gently until the black precipitate has dissolved.

(6) Dilute to 150 ml. and cool.

(7) Add 6 ml. of ferric-ammonium alum indicator solution.

(8) Run in 0.1 *N* potassium thiocyanate solution until the precipitation of silver thiocyanate is complete and one drop suffices to cause a permanent red coloration.

(The potassium thiocyanate solution should be standardized against 0.1 *N* silver nitrate according to the above procedure.)

*Calculations.*

(1) Standardization of potassium thiocyanate. Titrate 20.0 ml. of 0.1 *N* silver nitrate with thiocyanate.

Normality of the KCNS solution $=\frac{2}{V}$, where V is the volume of the thiocyanate (KCNS) solution used.

(2) Titration of silver. Multiply the volume of thiocyanate solution used for 10 ml. of the plating bath by the normality of the KCNS (found in 1) and by the appropriate factor to obtain the concentration of silver.

| *To obtain:* | *Multiply ml. by normality of KCNS and by:* |
|---|---|
| Silver, grams per liter (g/l Ag) | 10.8 |
| Silver, troy ounces per gallon (troy oz/gal Ag) | 1.31 |

4. *Other Determinations:*

Constituents of the plating solution other than those discussed above need not be determined for control purposes. It is of course advisable to know the extent of contamination by such constituents as iron, copper or mercury, but these may be determined annually unless there is reason to suspect that their presence is exerting a specific harmful effect on the process of plating. Ammonia can be determined but has no practical significance at this time. The methods for the determination of these substances are described in the complete report of this investigation (1).

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## TIN PLATING OF CAST IRON PISTONS

By G. W. Glasson
Oakland Motor Car Co., Pontiac, Mich.

Although this paper deals primarily with one automobile manufacturer's method of tin plating of cast iron pistons, nevertheless the methods which have been developed over the last three years by other manufacturers and have been adopted for mass production, are just as applicable and just as necessary where cast iron pistons are similarly fabricated. The primary object of tin plating cast iron pistons is to insure a more perfect fit between the piston and the cylinder bores. The tin also acts as a bearing metal. The original process of tin plating pistons has been used on more than one million cast iron pistons and has been used by other leading motor car manufacturers.

PROCESS:

(1) The cast iron pistons are prepared for plating, in which operations the pistons are machined and the sides finish ground,

and the piston marked for size. Pistons are checked 100% for diameters with an amplifying gauge and marked indicating size, stamped on the inside of the piston. The diameters are in five sizes of .00025″ each. The pistons are then loaded on a tree plating rack holding 10 pistons. The rack is made of commercial brass. The compound for rough and finish grinding the O. D. of the piston is 1 to 2 ounces per gallon of sal soda to insure a clean surface before plating.

(2) The pistons are then cleaned in a direct-current electric cleaner for approximately 2 to 3 minutes. The cleaning solution is 2 ounces per gallon of GMC 2401-M metal cleaner (35% fluffy soda ash, 55% tri-sodium phosphate, 10% caustic soda) and operated at a temperature of 160 to 180° F. The current density is approximately 20 amps. per square foot. (Reworked, or stripping of plate is done in this cleaner.)

(3) The work is then rinsed in clean cold water.

(4) Pistons are then placed in an acid dip from 3 to 5 minutes to etch the surface. The solution ranges from 5 to 10% muriatic acid in cold water.

(5) The work is rinsed in clean cold water.

(6) An alkali dip is the next operation. A solution of 2 ounces of caustic soda per gallon of cold water is used to neutralize the acid.

(7) The work is rinsed in clean cold water.

(8) Pistons are then set in a storage tank containing cold running water.

(9) The next operation is tin plating. The work is plated in a semi-automatic plating tank, the time ranging from 55 to 65 minutes to deposit .00175″ to .00225″ of plate on the diameter—or a nominal of .001″ of tin per side of piston. The cathode current density ranges from 20 to 25 amperes per square foot. The EMF, 5 to 8 volts. The plating solution is 12 to 14 ounces of 40% sodium stannate GMC 1819-M operated at a temperature of 140 to 160° F. The anode to cathode ratio is 1 to 1. Approximately 20% of the anode area is steel. Only pure Straits Tin is used for anodes. The plate is very dense in structure and a dull gray in color.

(10) After plating, the pistons are rinsed and set in cold water to cool. They are then checked for deposit and size on an amplifying gauge which is set .00175″ higher than the gauge on

the first operation—the size to conform to the mark indicating size on the inside of the piston. The plating limit for one size is .00025″.

(11) The machine operations are then completed—such as rough and finish turning the piston ring grooves and ring lands, drilling oil holes, finish grinding the head, and boring the skirt for weight. Pistons are fitted to the cylinder bores with a 10 to 25 pounds pull on a .0015″ feeler.

The process has been described specifically for the plating of pistons at the Oakland Motor Car Company, Division of General Motors. Modifications of this process in machining and plating better suited to modified processes by other motor car manufacturers are used due to manufacturing methods.

In conclusion, we cannot impress upon you too strongly the necessity of a chemically clean surface previous to plating to produce a perfect deposit. By so doing the maximum, a perfect bond and tin plate is produced on the piston and adds to the rest of the good workmanship on other parts which goes to make up a quality product.

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## ELECTRO-TIN PLATING

**By R. E. Maeder**
**Frigidaire Corporation, Dayton, Ohio**

In the manufacture of electric refrigerators a large amount of copper and brass is used. Much of the copper and brass is used inside the refrigerator in more or less intimate contact with food. The atmosphere on the inside of a refrigerator is quite corrosive to most metals. It is necessary to coat most metals with something to protect them from this corrosion. However, it is desirable for several reasons that the coating be metallic in character.

Back in the fall of 1925, Frigidaire had an assembly which they were coating with pure tin. They were tinning in the time-honored fashion of dipping the various parts in molten tin and wiping off the excess with a rag or a sheepskin. These parts were then soldered together with pure tin solder. This gave a fairly satisfactory job, but the process was difficult and expensive. It was thought that if the assembly could be electroplated a large saving in labor and tin could be effected.

In giving consideration to various electroplated metals, only four offered any possibilities. These were tin, cadmium, nickel and

chromium. Tin was the logical metal to use. Cadmium did not offer the desired protection. Nickel and chromium both lack the necessary "throwing power."

In going over the literature on electro-tin plating at that time, we found that the known tin baths were of two kinds, namely: the acid bath and the alkaline bath. Both of these types of baths offered objections that made them impractical for use on work such as occurs in the building of electric refrigerators.

The acid bath, as was demonstrated in a short time, did not have the "throwing power" necessary for plating the above mentioned assembly. Then, too, the character of the deposit made it impractical for obtaining the required heavy deposits due to its tendency to tree.

The existing alkaline baths that were investigated at that time were entirely too unstable. In order to obtain a uniformly thick deposit on work as large as an evaporator it is necessary to have a stable solution.

Late in the year 1925 we found that the Roessler & Hasslacher Chemical Company were offering a tin compound which they recommended for use in electro-tin plating. We ordered some of this material, dumped the current solution from our experimental tank, and made up a sodium stannate solution according to the formula submitted by them. I do not remember this formula, but we got the first real encouragement from using a solution with sodium stannate as the tin compound. However, as we used this solution experimentally, various troubles were encountered. After a few runs the solution began to decrease in both "throwing power" and efficiency.

We decided that the alkalinity of the solution increased with use, due probably to low anode efficiency. This decrease in efficiency was contributed to by the following conditions:

First, poor anode contacts. As the dried sodium stannate is a good insulator for low voltages, care is necessary in keeping anode bars and hooks clean.

Second, too high anode current density causes the anodes to become passive.

Third, which amounts to the same thing, insufficient anode surface.

We tried by various methods to reduce this free alkalinity, using tin oxide muriate of tin, hydrochloric acid, acetic acid, etc. We

came to the conclusion that muriate of tin offered the best means for our purpose of controlling the alkalinity of the solution. By this time we had evolved a theory (which I am not going to attempt to prove) explaining what happens when a sodium stannate solution is electrolyzed.

The theory is that a solution of sodium stannate which contains approximately two pounds per gallon, hydrolizes to the proper hydroxyl ion content, thereby obtaining maximum throwing power and at the same time giving nearly 100% anode corrosion. It seems probable that a small amount of stannous tin is present as sodium stannite, which in my opinion has an effect on the "throwing power" of the solution. Very small additions of stannous tin increase the "throwing power" of the solution. Too much of it causes a pulverent deposit.

An increase in the sodium hydroxide content above the optimum amount causes a decrease in "throwing power." If these assumptions are correct, the addition of muriate of tin should accomplish two things. First, it reduces the free sodium hydroxide content and second, it increases the amount of sodium stannite.

While we have never determined the stannous tin content of our tin plating solution, we have attempted to measure the hydroxyl ion concentration by means of the Hellige color standards. The fact that the hydroxyl ion concentration is always 11.6 pH for a solution in good working condition leads us to believe that the sodium hydroxide content is buffed at pH 11.6 by the sodium stannate.

A simple reaction showing the effect of muriate of tin may be given as follows:

4 NaOH plus $SnCl_2$—$Na_2SnO_2$ plus 2 NaCl plus 2 $H_2O$

| | *Solution Composition* |
|---|---|
| Sodium Stannate | 32 oz. per gallon |
| Muriate of Tin | 1/32 oz. per gallon |

A wide variation in the sodium stannate concentration is permissible. However, we keep our solution at this concentration as it makes a good stable solution which is easy to control. The only objection to the high concentration is the initial cost and the loss through dragout, for this solution does not rinse freely.

*Operating Conditions*

Anodes should be pure tin.

Ratio of anode to cathode surface: Minimum 1½ to 1 or the

anode surface should be such that the anode current density is not greater than 15 amps. per sq. ft.

Cathode current density: 15 to 45 amps. sq. ft.

The solution temperature should be 110°-130°F.

The 130°F. maximum is the temperature at which insoluble tin oxides begin to precipitate in excessive amounts.

Voltage: 4 to 8 volts.

*Control of the Solution*

The control of the sodium stannate solution is very simple as operated in our plant. The tin content is kept up by addition of a concentrated solution of sodium stannate. This solution is made up in a separate tank by using heat and air agitation and can be carried at about 4 lbs. per gallon. It is then allowed to settle and only the clear solution is added to the plating tank.

Muriate of tin is added in small amounts as necessary. The skill of the operator is largely relied upon to determine this in order to avoid diminishing "throwing power." However, if the anode current density is at or below 15 amps. per sq. ft., it is possible to operate for months without adding muriate of tin. To do this it may be necessary for the operator to vary the current density.

It is obvious that the less muriate of tin used the better. For one thing, the solution builds up in sodium chloride with the continued use of muriate of tin. While a small amount of chlorine in the solution is probably beneficial from the standpoint of anode corrosion, large amounts of salt in the solution can only be detrimental.

The operator controls the current density largely by the appearance of the anodes. The anodes will have a peculiar greenish-yellow color during electrolysis when the solution is working properly. The operator endeavors to keep the current density as high as possible without losing this color. As soon as a slight brownish color appears on the side of the anode toward the work he lowers the current density a little.

*Application*

There are 45,000 gal. of tin plating solution in our plant.

We electro-tin evaporators, both for household refrigerators and for large commercial installations.

Many thousands of feet of copper tubing are plated each year. This tubing is plated in 20 to 60-foot lengths, in coils about two feet in diameter.

At one time our ice tray was electro-tinned and given a semi-luster by scratch brushing. The solution works well in barrel plating. Many small parts are plated for appearance and for corrosion resistance.

*Corrosion Tests*

For the reason that we know of nothing better we have at times used the salt spray test for an accelerated corrosion test of electro-tin plated copper. Our evaporator coils with a plating time of 25 minutes withstood the salt spray 400 to 600 hours before showing copper.

The ice tray which was plated 30 minutes and scratch brushed was required to withstand 1000 hours salt spray without showing copper.

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# BRANCH NEWS

## BOSTON BRANCH

Boston Branch met Thursday, June 2, at the American House with President Gale in the chair.

Communications and bills were read and approved.

A report was made by the chairman of the chemistry class, who stated that it was a very good class and that he was able to keep the whole class together, although some of the members were out of work. He returned a balance of $4.27 and a vote of thanks was given him for the good work he had done in keeping the class together.

The following officers were elected for the coming year: President, C. O. Hardy; Vice-President, C. F. Campbell; Secretary-Treasurer, A. W. Garrett; Sergeant-at-Arms, W. Jones; Librarian, F. Mackie; Board of Managers, Chairman Bart. F. Lee, Fred Mullea and Harry J. Lack.

We had the pleasure of having Mr. Frank Clarke of Springfield Branch with us and he was given the honor of installing the new officers and he did the work very well and a rising vote of thanks was given Mr. Clarke.

The question of delegates to the convention was taken up and the following delegates were elected: Mr. C. F. Campbell, Mr. Louis A. Gale and Charles O. Hardy. If they cannot attend Springfield Branch will act as proxy for Boston Branch.

Boston Branch will not meet again until September 8, 1932.

Meeting adjourned at 10:30 p.m.

ANDREW W. GARRETT, *Secretary-Treasurer.*

## DETROIT BRANCH

Detroit Branch held its regular monthly meeting at Hotel Statler, Friday evening, June 3, 8:15 p.m., with a large attendance. President Hansjosten presided. The minutes of the previous meeting were approved as read.

The installation of the new officers was very well performed by our Mr. E. G. Lovering with well chosen remarks. The Board of Managers audited the report of the financial condition of Detroit Branch for the fiscal year ending May 30, 1932, which was read and approved. The application of Walter Wrenn as an active member was turned over to the Board of Managers.

It is with great regret that we received the resignation of Mr. Elmer Woodmansee as he is now in the hotel business in Denver and he cordially extends an invitation to all members of the A. E. S., especially Detroit Branch. His resignation was accepted with reluctance.

The feature of the evening was a paper presented by Mr. Allen W. Carter on the finishing of brass stampings for automotive hardware as practiced in one of our leading lamp manufacturing plants. The fabrication and the finishing was described in detail and was well received by all those present.

## THE FINISHING OF BRASS STAMPINGS FOR AUTOMOTIVE HARDWARE

**By Allen W. Carter**

I will just touch very lightly on the fabrication of these articles as we are not as much interested in that operation as the polishing, buffing and plating.

In the first place great care must be exercised to obtain a good grade of brass. By that I mean a grade that is free from flaws, dirt and other impurities that occur in the manufacture of the alloy. This is very essential because all these things tend to increase the cost of finishing the product.

The first operation, the fabrication of the product, has to be carefully handled to prevent die-mark dents from handling and rings from the edges of the dies. The smoother and more even the product is when it reaches the polishing room the less it costs to produce a good finish.

After the object is fabricated it is washed in a washing machine consisting of an alkaline cleaner and water rinses to free it from the oil and grease accumulated in the drawing operation.

The article is now ready for the polisher where all die marks, rings and other abrasions are polished out. This consists of a two-wheel operation, No. 120 and No. 140 emery on grease wheels.

The next operation is the buffing or cutting down operation. This is accomplished on a paper buff wheel using a Tripoli composition to do the cutting.

After the cutting down operation, the articles are again run through the washing machine to remove all excess Tripoli and dirt.

They are now ready for the coloring. This is done on a cotton

wheel, using a good saponifiable white finish. The articles are now given a rigid inspection and if satisfactory are sent to the plating room.

In the plating room everything is first racked on spring tension hooks to insure a good contact. The work is then immersed in an alkaline cleaner for 1½ minutes at 12 volts pressure direct current. They are immediately taken from this cleaner and immersed again in a reverse cleaner, 12 volt pressure for 30 seconds to remove any oxide formed by the direct cleaning. The next operation is a water rinse in clear running water, a cyanide dip, another water rinse and an acid dip to neutralize any alkali that happens to remain on the article or rack. They are then placed in a storage tank to await the nickel operation. This is accomplished in a semi-automatic tank containing 4000 gals. nickel solution. The cycle is set at 13 minutes with a 6 volt pressure giving an amperage from 25 to 30 amps. per sq. ft. The nickel solution is a regular Watts solution with some modifications.

Thirty-two to 38 oz. Ni. $SO_4$, 9 to 11 oz. Ni. $CL_2$, 4 to 6 oz. $H_3$ $BO_3$. 99+ depolarized nickel anodes. Temperature 110° to 120°F. pH 5.6 to 6. Colorimetric hydrogen peroxide is added every night to control hydrogen ion and prevent pitting. If solution becomes alkaline we add $H_2$ $SO_4$ to correct this condition. But if the solution is kept at the right concentration this condition very seldom occurs. A daily check of pH is maintained and a weekly analysis for Ni. $SO_4$, Ni. $CL_2$ and $H_3$ $BO_3$. The solution is filtered once a week. On heavy production the solution is pumped out every two weeks and the sediment cleaned out of the bottom of the tank. The anodes are washed and the solution filtered back into the tank. The anode rods are cleaned and the anodes replaced in the tank and everything is ready to go for another two weeks.

After the articles are nickel plated they are again sent to the buffing room and the nickel is very carefully colored. This is done with a loose-leaf cotton buff, using white finish to color.

The next operation is the chrome plating. The articles are again racked on spring tension hooks with plenty of clearance to prevent shading. They are immersed in a caustic soda and cyanide cleaner for 30 seconds, from there to a water rinse and into an alkaline cleaner for one minute, water rinse, acid dip, water rinse, cyanide dip, water spray, then into chrome tanks. These tanks are

glass lined with a water jacket on the outside to regulate the temperature, 6% antimonial lead anodes with 1" spacings. These anodes are taken out and cleaned every two weeks in a solution of sodium chloride and hydrochloric acid. The chromium solution contains 45 to 50 oz. Cr $O_3$ per gal. with $H_2$ $SO_4$ on a ratio of 1 to 100 Cr $O_3$. Plating time 1½ to 2 minutes with 250 to 300 amps. per sq. ft. The work is rinsed in a drag-out tank and then through a water spray unracked and sent to the buffing room.

The articles are again colored on a cotton wheel mainly to dry them off and take off any water stains that have appeared and then sent to the inspection booth. After going through a very rigid inspection they are sent to the assembly room.

The next speaker of the evening was Mr. R. R. Tanner, president of the Metal Finishing Research Corp., who spoke on present day practice and described in detail Parkerizing, Boudlerizing and Parkolite, illustrating his remark with stereopticon views. Quite a number of questions were asked of the speaker and were answered to the satisfaction of all. A vote of thanks was extended to Mr. Carter and Mr. Tanner.

A vote of thanks was extended to the Park Chemical Co., for the refreshments and cigars.

Meeting was adjourned till the first Friday in September.

CHAS. E. MARKER, *Secretary-Treasurer.*

## BRIDGEPORT BRANCH

The regular monthly meeting of the Bridgeport Branch was held at 8:30 p.m. on June 3, 1932, in the Chamber of Commerce rooms of the Stratfield Hotel. There were twenty members present. A roll call of officers found only two absent. The minutes of the last meeting were read and accepted as read. The sick committee reported no one in ill health.

The entertainment committee, with plenty of fun in store for the next few months, reported progress. Announcements, to go to the members in the future, will reveal the large outing, for which Al Rosenthal, Bill Stratton, Ben Kuster and Bill Thompson are working earnestly.

Delegates were instructed as to the coming Convention.

The Treasurer's report was read and all bills were ordered paid. The meeting adjourned at 10:15 p.m.

Installation of officers took place at the 8th Ward Democratic Club, with M. A. Rosenthal in charge. The following officers were installed:

President, Mr. George Wagstaff; Vice-President, Mr. Al Rosenthal; Secretary-Treasurer, Mr. Wm. Flaherty; Sergeant-at-Arms, Mr. Charles Walsh; Librarian, Mr. Hermon Brown; Board of Managers: Mr. Wm. Stratton, Mr. Wm. Thompson and Mr. John Oberander.

Following the installation, the members were pleasingly entertained and well fed by Mr. Rosenthal, the noted *chef* of the Bridgeport Branch, and the installation came to a climax at a late hour.

WM. H. FLAHERTY, *Secretary-Treasurer.*

## ROCHESTER BRANCH

On Friday evening, May 20, Rochester Branch held its monthly meeting with a very good attendance. Many of our members are attending the meetings and we hope to see more.

Rochester held their annual election of officers for the coming year and elected the following:

President, Frank J. Kohlmeier; Vice-President, Chas. Heks; Secretary-Treasurer, Chas. Griffin; Librarian, Henry Cameron; Board of Managers: L. P. Gaitland, G. A. Lux, C. A. Reama.

Delegates to Philadelphia Convention: Chas. Griffin, S. P. Gaitland, C. A. Reama. Alternates: P. A. Lyons, J. J. Desmond, G. A. Lux.

Rochester hopes for a very successful year with the new officers in their respective chairs at the June meeting.

CHAS. GRIFFIN, *Secretary.*

## HARTFORD-CONNECTICUT VALLEY BRANCH

The Hartford-Connecticut Valley Branch A. E. S. held their regular monthly meeting on Monday evening, May 23, at the Hartford Chamber of Commerce, Hartford, Conn.

The meeting was called to order at 8:30 p.m. with President Fleming in the chair. Minutes of the previous meeting were read and accepted. One bill was voted paid, said bill being for our fourth quarter per capita tax for the amount of twenty-two dollars and five cents ($22.05). All communications were read and placed on file.

At this meeting we nominated and elected officers for the coming year, and the following were elected to office:

President, Edw. Fleming; Vice-President, T. J. Murray; Secretary-Treasurer, V. E. Grant; Librarian, Jas. E. Beloin; Board of Managers: H. R. MacFadyen, Geo. Vibberts, W. J. Kennedy.

Delegates to National Convention: W. J. Kennedy, W. E. Seidel, T. J. Murray; Alternates: V. E. Grant, W. T. Jordan, Edw. Fleming.

Delegates were instructed as to how to vote on different articles to be brought up at the National Convention.

As there was no speaker for the evening and no further business to be handled, the meeting adjourned at 10:00 p.m.

V. E. GRANT, *Secretary.*

## ST. LOUIS BRANCH

Regular meeting of the St. Louis Branch was held at the Lea Salco plant, Friday, May 13. In the absence of Pres. R. Kells meeting was called to order by Vice-Pres. Al. Barth. Minutes of previous meeting were read and approved. On report of officers and committee, Mr. Musick reported that the get-together party was enjoyed by all. He was then given a vote of thanks and told to serve again next year. Election of officers then took place. Officers elected are as follows:

*Pres.*, A. BARTH, 5336-A Grant Ave., St. Louis, Mo.; *Vice-Pres.* H. H. WILLIAMS, Murdock, St. Louis, Mo.; *Sec'y-Treas.*, CHAS. T. MCGINLEY, 8214 Fairham, U. City, Mo.; *Librarian*, F. MENNINGES, 4019 Tholozan Ave., St. Louis, Mo.; *Board of Managers*: E. MUSICK, GEO. MILLER, H. J.

RICHARDS. *Delegates to Convention*: E. MUSICK, H. H. WILLIAMS, A. BARTH. *Alternates to Convention*: JOHN VOGT, Belleville, Ill., PAUL MILLER, Evansville, Ind., E. HUL, Wichita, Kans.

There being no further business, meeting was turned over to Mr. Williams, who asked Dr. Stout to take the floor. He spoke of a book gotten up by one of the students at Washington University on research work on cadmium plating and zinc plating, explained it and showed charts, which was very interesting, and also that there was a lot of time and patience spent in getting up chart, for which St. Louis Branch is very thankful to Dr. Stout for passing on this information.

Meeting adjourned at 10:30 to meet on June 10, 1932. At this meeting installation of officers will take place.

CHAS. T. MCGINLEY, *Secretary.*

## ANDERSON BRANCH

The May 2 meeting was called to order at 7:45 P. M. at the Anderson Y. M. C. A. Roll call of officers showed Mr. Cotton absent.

Minutes of the April business meeting were read and approved.

Bills from the Supreme Society and Short Printing Co. were read and ordered to be brought up again at the next meeting.

A letter from the Chicago Branch requesting support in bringing the 1933 Convention to that city was read. Mr. Phelps moved that delegates be instructed to support Chicago in this matter. The motion was seconded and passed.

Mr. Wagner moved that the second meeting of the month be discontinued during the summer. The motion was seconded and passed.

Election of delegates was then held, the following being nominated: Messrs. Cleaver, Phelps, G. M. Cole, Wagner, G. S. Cole, C. Wilson, Onksen.

In the balloting, Messrs. Wagner, Onksen and G. S. Cole were elected as delegates and Messrs. Wagner, Onksen and G. S. Cole were elected as alternates.

The branch then proceeded with election of officers. The following were nominated for president: Messrs. Kaegi, G. S. Cole, Cleaver, Phelps and Wagner. Messrs. Phelps and Wagner declined to run and their names were withdrawn in order by Mr. Kaegi who nominated them. Mr. Cleaver was elected on the first ballot by a majority vote, in spite of his protests against running again. Mr. Cleaver complied with the general request for an inaugural speech.

For Vice-President, Messrs. Kaegi and G. S. Cole were nominated, Mr. Kaegi was elected by a one-vote majority.

For Secretary-Treasurer, the following were nominated: G. S. Cole, G. M. Cole, G. W. Onksen. Mr. G. S. Cole was elected by a wide majority.

For Librarian: Messrs. Castell and G. M. Cole were nominated, Mr. Castell winning by a one-vote majority.

For Board of Managers, the following were nominated: Messrs. Phelps, Onksen, G. M. Cole, Hammond, C. Wilson. The first ballot resulted in a tie for third place, and on the second ballot, Messrs. G. M. Cole, Hammond, and C. Wilson were elected.

Mr. Kaegi presented a report on progress of arrangements for the banquet and called a committee meeting following the regular meeting.

The meeting adjourned at 9:30 P. M.

R. M. WAGNER, *Secretary-Treasurer.*

## DAYTON BRANCH

On Saturday, June 11th, members of Dayton Branch A. E. S. and their families gathered "Somewhere" in Green county for what, we hope, is to be an annual affair. Shortly after noon members and their families gathered at the picnic grounds and after a few introductions we were all acquainted and started to enjoy ourselves to the fullest extent.

The feature event of the afternoon was the ball game, managed and directed by those two well-known campaigners, Walter Fraine and Bob Suman. The team managed by Mr. Fraine and known as "Fraine's Catamounts" engaged in combat the one managed by Mr. Suman and known as "Suman's Platers."

For thrills, spills and what not this game far exceeded any on record, and it is needless to say that it was a hard-fought contest, with the outcome ever in doubt until the last man was retired. However the final score was 5 to 4 in favor of Fraine's Catamount team.

While the team managed by Mr. Fraine won the ball game, it remained for the losing team of Mr. Suman's to furnish the outstanding heroes of the contest, for had it not been for the effective pitching of Bill Hohman and the extra heavy hitting of his team mate and manager, the score would have been much more one-sided.

The committee responsible for the success of the picnic were: Mr. Cusick, Mr. Hohman, Mr. Folz and their wives. We believe in giving credit where credit is due, thus our reason for including the women, for we feel certain that these men had nothing to do with the baked ham or beans or the roast beef and a host of other good things that helped to make up the menu.

The committee and their wives are to be congratulated on the success of their efforts, and in the future, when planning our picnics we shall not forget those who have done so well in giving us this outing with an abundance of good things to eat and drink.

Along with the efforts of the committee and the congenial spirit of the crowd it was all in all One—Grand—Picnic—and expressions of a desire to attend many more such gatherings were frequently heard throughout the afternoon.

WARD PROTSMAN, *Secretary-Treasurer.*

## LOS ANGELES BRANCH

The regular monthly meeting was held May 11, at the Rosslyn Hotel. The meeting was called to order by President E. W. Francis. Communications were read and the bills were ordered paid.

After a letter from the Chicago Branch, seeking the support of this branch for their contemplated request to hold the 1933 Convention in

Chicago, was read, it was moved and seconded to support the Chicago Branch in their efforts.

When a transfer was presented from the Chicago Branch to the Los Angeles Branch, Mr. Ernest Lamoureux was voted in to the Los Angeles Branch and received a big hand, this being a large grotesque hand, 2x3 feet.

The committee of eleven members, called the "New Meeting Location Committee" reported their approval of holding the regular monthly meeting in the Rosslyn Hotel. The entire body voiced their approval of this latest change.

The officers' committee reported on the delinquent members and recommended that the list of members be checked over carefully and reported at the next, June 8, meeting with the exception of eight members who were voted suspended.

A resolution was read by the secretary and submitted to the meeting as to wit:

"We offer the following as a resolution for approval by the Los Angeles Branch:

"That a committee of five be appointed to be known as 'The Social Activities Committee,' to promote social affairs within the Branch in the form of dinners to be followed by card games, consisting of bridge and five-hundred, for which prizes will be given to the first and second high score in each game.

"The dinners to be priced at fifty cents per plate, and a charge of 25 cents extra per person for the card games. The profits from these activities to be turned over to the Secretary-Treasurer of the Branch and to be retained in a separate fund. And to be used for any purpose within the discretion of the Branch."

The motion was carried and the members making the resolution were ordered to stand as the first party committee.

The question of Proxy for Los Angeles' representation at the Philadelphia Convention was brought up and a motion was made, seconded, and carried to give our Proxy to the Chicago Branch, a notice of which was forwarded immediately.

The nomination and election of officers for the ensuing year resulted as follows:

President, Bernhardt Foss, 118 W. 36th Street, Los Angeles, Calif. Vice-President, M. D. Rynkofs, 1354 W. 25th Street, Los Angeles, Calif. Secretary-Treasurer, Earl Coffin, 2910 S. San Pedro Street, Los Angeles, Calif. Librarian, W. E. Hurd, 1953 E. 76th Street, Los Angeles, Calif. Board of Managers: C. E. Thornton, E. W. Francis and E. P. Robinson. Sergeant-At-Arms, R. U. Gripp. Delegates to Convention: R. U. Gripp, E. W. Francis and J. Corbit. Alternates: E. R. Williams, T. Krueder and H. Garside.

The Librarian took over the meeting and found a number of questions in the box, for answers to which please refer to your next review. Mr. E. R. Williams passed some samples of the new "Caddux" plate, which proved to be very interesting to those who examined the pieces displayed.

The following were found in the question box:

1. *How can a plate of nickel copper and nickel be stripped off?*
   Use nitric 1 part and 2 parts of sulfuric. No water to be present.
2. *What is a standard plate?*
   See May, 1932, Review for answer.
3. *What effect will a small amount of chrome solution have on a cyanide copper solution?*
   It will oxidize any work that may be put in, therefore cause peeling.
4. *What makes a cleaner solution (electric) deposit copper?*
   The copper or brass articles cleaned leave a trace of copper salts in the cleaner which in turn plates out on other work when cleaned and direct current used.
5. *What will cause a cyanide copper solution to streak?*
   Add Rochelle salts. About 3 oz. to gallon.
6. *What is the cause of acid copper having a granular sediment on the top of the work?*
   Filter solution, to eliminate rough plate.
7. *Has anyone had experience in using cadmium oxide in a copper solution for bronze plating?*
   Cadmium oxide must be added carefully to the copper solution to obtain desired color.
8. *How can you tell when an addition of cyanide is needed in a gold solution?* Thank you if your answer is correct.
   First, by the throwing power.
   Second, by cleanliness of the plate.

The meeting adjourned at 10:30 p.m.

M. D. RYNKOFS, *Secretary.*

## MILWAUKEE BRANCH

The regular meeting was held on June 9, 1932, at Lipps Hall, 3rd and W. Highland Ave. In the absence of President M. Nishwitz, Vice-President Paul Krause called the meeting to order. Patrick J. Sheehan installed the newly elected officers, after which all partook of lunch and refreshments. During the months of June, July and August Milwaukee Branch will have only one meeting a month, that being on the second Thursday.

We regret to announce the death of a member of Milwaukee Branch, Mr. Jos. Hornwall, 1208 S. 36th St., Milwaukee, Wis., who died May 21, 1932.

FRANK J. MARX, *Secretary-Treasurer.*

## APPLICATIONS

WALTER MEVIN, 1706 Shephard Street, Windsor, Ontario.....Detroit
CHAS. H. HOWARD, 731 N. Marshall St., Milwaukee, Wis.....Milwaukee
JOHN A. STORM, 1044 Third St., Fullerton, Pa.....Philadelphia
CLARENCE J. NUMES, 319 Delmas Ave., San Jose, Cal.....San Francisco

## ELECTIONS

CHAS. H. HOWARD, 731 N. Marshall St., Milwaukee, Wis.....Milwaukee
JOHN A. STORM, 1044 Third St., Fullerton, Pa.....Philadelphia
CLARENCE J. NUMES, 319 Delmas Ave., San Jose, Cal.....San Francisco

## TRANSFER

M. H. CORBIN, associate member from New York Branch to.....Cleveland

## CHANGE OF MEMBERSHIP

C. H.PROCTOR from associate membership to active membership....New York

## RESIGNATIONS

ELMER W. WOODMANSEE .....Detroit
HENRY M. WRITER, 3rd and Segley Ave., Philadelphia, Pa. Philadelphia
E. HOWARD, 110 Slade Ave., Elgin, Illinois.....Detroit
GEO. NOLLMAN, 2727 Grand Ave., Louisville, Ky.....Indianapolis

## SUSPENSIONS

RICHMOND B. HOLMES .....Baltimore-Wash.
MATHEW J. KRAFT .....Baltimore-Wash.
WM. F. PLITT .....Baltimore-Wash.
CHAS. C. SEYMOURE .....Baltimore-Wash.
EDGAR WILLIAM .....Detroit
ED. ATZENHOVE .....Detroit
W. REAM .....Detroit
THOS. FERGUSON .....Detroit
T. J. CONNOR, 2629 Bealey St., Philadelphia, Pa.....Philadelphia
P. D. HILBERT, 606 E. Philadelphia Ave., Boyertown, Pa. .....Philadelphia
P. A. LOWER, 6013 Worth Street, Philadelphia, Pa. .....Philadelphia
R. E. McKEE, 3 Harvin Road, Upper Darby, Pa. .....Philadelphia
C. F. NEIDIG, 731 Liberty Street, Allentown, Pa. .....Philadelphia
J. L. STITZEL, Box 32, Fleetwood, Pa. .....Philadelphia
F. E. SHADELL, 26 E. Philadelphia Ave., Boyertown, Pa. .....Philadelphia
L. STAHLCUP, 1416 Lenox Ave., Philadelphia, Pa.....Philadelphia
WM. WILLIAMS, Esterbrook Pen Co., Camden, N. J. .....Philadelphia
FLOYD THOMPSON .....St. Louis
R. J. LOCKIE, 1125 Queen Ann Pl. .....Los Angeles
E. H. PANGBORN, 214 N. Curtis .....Alhambra, Cal.
A. J. LUPIEN, 3220 Bellvue Ave.....Detroit, Mich.
LEA ROY MILLER .....Los Angeles
W. N. WENTZ, 5300 Van Ness Ave. .....Los Angeles
LEROY WATT, 2124½ S. Vermont Ave.....Los Angeles
JAMES L. DYE, 145 W. 93rd St. .....Los Angeles
F. H. SLATER, 1819½ N. Western Ave. .....Los Angeles

## DEATHS

MR. F. BURR, St. Charles, Illinois. .....Chicago
GEO. DULGARIAN .....St. Louis
MR. J. MAGILL .....Toronto
MR. WILLIAM STOPPER, 2042 N. Tripp Ave.....Chicago, Ill.

## RESEARCH COMMITTEE

*Chairman,* JACOB HAY.....6920 Ottawa Ave., Chicago, Ill.

*Sec.-Treas.,* WALTER FRAINE.....507 Grand Ave., Dayton, Ohio

S. E. HEDDEN.....227 Fifth Ave., Aspinwall, Penn.

WILLIAM F. GUILFOILE.....14 Oakland St., Waterbury, Conn.

DAN WITTIG.....1221 N. Third St., Milwaukee, Wis

DR. WILLIAM BLUM.....Bureau of Standards, Washington, D. C.

MR. OSCAR SERVIS.....5305 Warner Ave., Chicago, Ill.

MR. N. E. ZADOWSKI.....1383 W. 65th St., Cleveland, Ohio

MR. W. S. BARROWS.....628 Dovercourt Road, Toronto, Canada

C. F. NIXON.....Ternstedt Manufacturing Co., Detroit

DR. H. S. LUKENS.....University of Pennsylvania, Philadelphia, Pa.

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## BUREAU OF EDUCATION

*Chairman,* MR. ALBERT HIRSCH.....1945 Airdrie St., Philadelphia

*Branch Representatives:*

Chicago Branch.....HAROLD FAINT

Waterbury Branch.....ELLSWORTH CANDEE

Los Angeles Branch.....M. D. RYNKOFS

New York Branch.....HENRY LEVINE

Philadelphia Branch.....DR. A. K. GRAHAM

Baltimore-Washington Branch.....DR. WM. BLUM

Cleveland Branch.....J. C. SINGLER

Hartford-Connecticut Valley.....RAY O'CONNOR

Worcester Branch.....M. H. FROMMANN

Toronto Branch.....C. KEMESH

Anderson Branch.....D. A. COTTON

Newark Branch.....PAUL A. OLDAM

Milwaukee Branch.....HENRY BINDER

St. Louis Branch.....H. H. WILLIAMS

Other Branch Representatives will be printed as received.